



國立陽明交通大學  
NATIONAL YANG MING CHIAO TUNG UNIVERSITY

# Deep Learning

## 深度學習

### Fall 2025

## Introduction

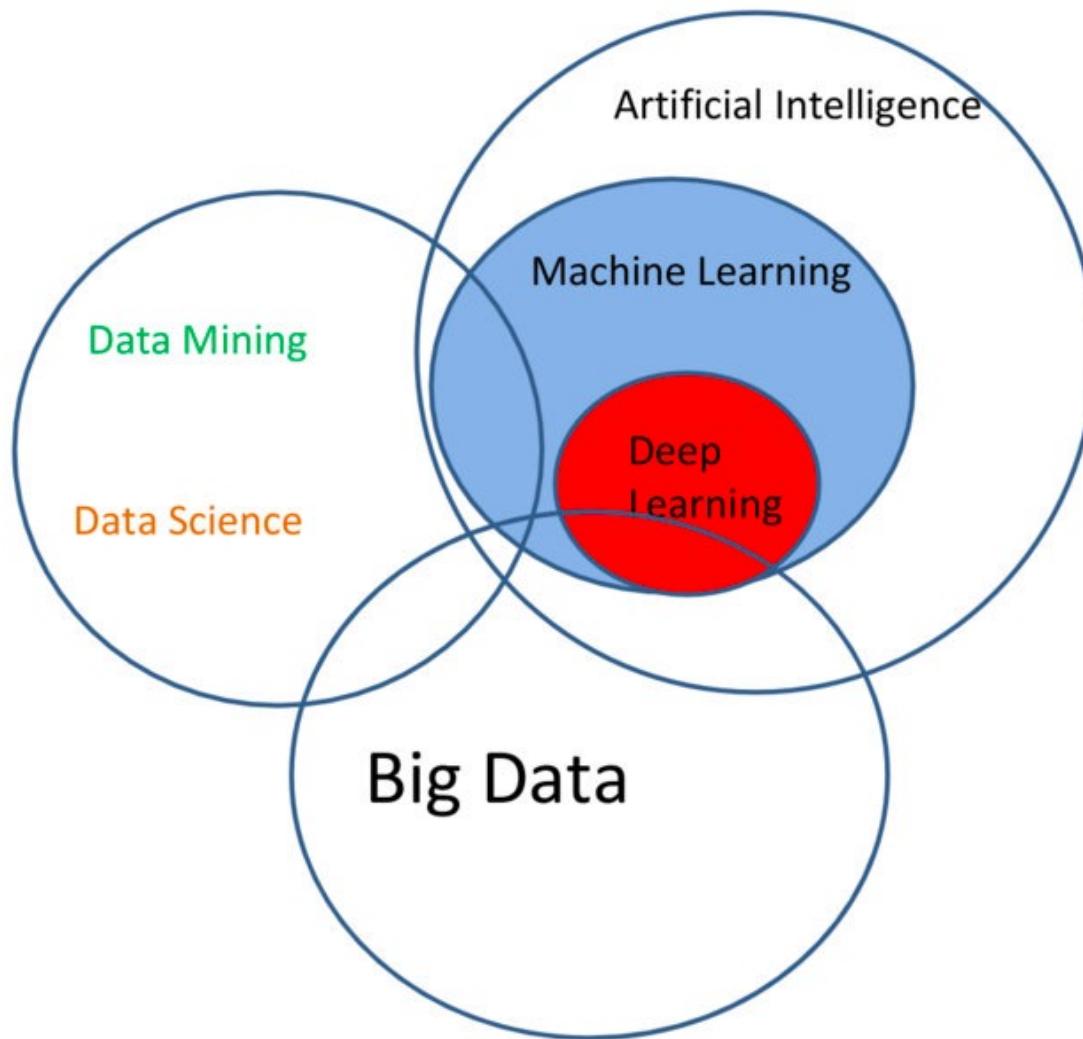
Prof. Chia-Han Lee  
李佳翰 教授



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- Figure source: Textbook and Internet
  - You are encouraged to buy the textbook.
  - Please respect the copyright of the textbook. Do not distribute the materials to other people.

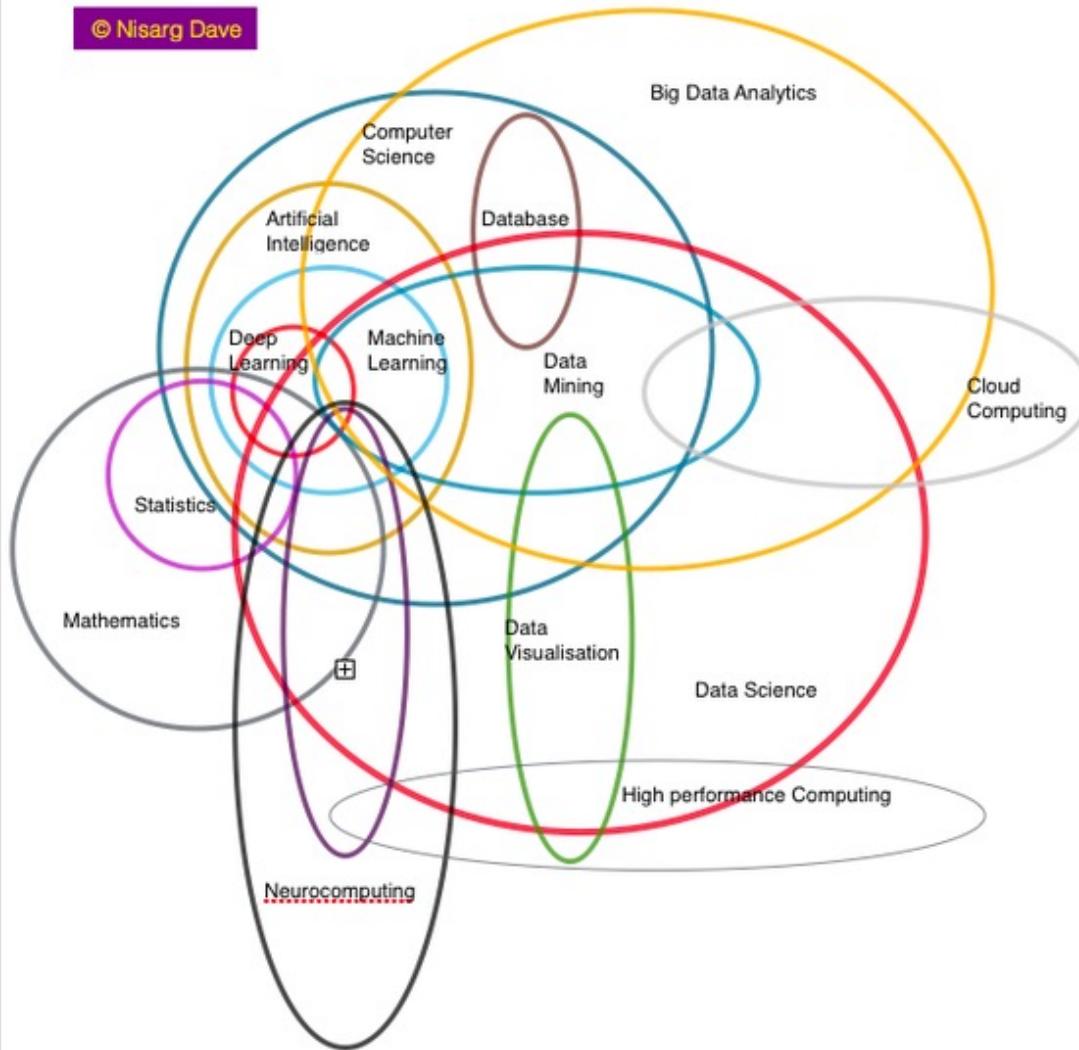


# AI, ML, DL, DM, DS, BD





# and more...

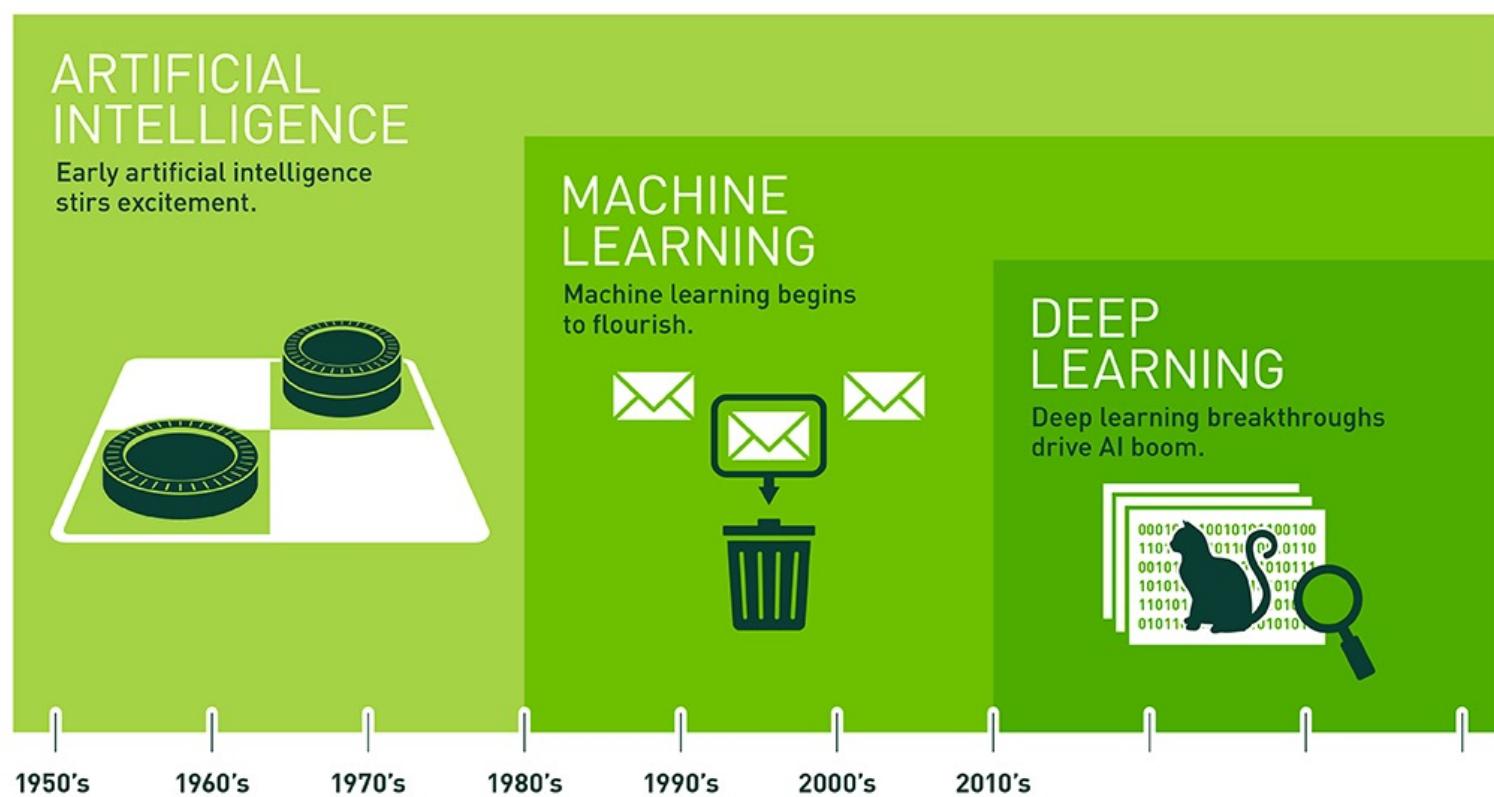




# **History of AI, machine learning, and deep learning**



# AI → ML → DL



Since an early flush of optimism in the 1950s, smaller subsets of artificial intelligence – first machine learning, then deep learning, a subset of machine learning – have created ever larger disruptions.



# History of AI

## A BRIEF HISTORY OF AI



1952

**Dartmouth Conference 1956:** the birth of AI. The proposal for the conference included this assertion: "every aspect of learning or any other feature of intelligence can be so precisely described that a machine can be made to simulate it"



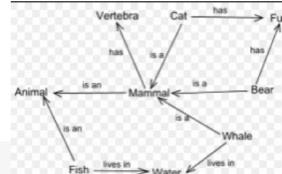
1974-1980

**The first AI winter 1974–1980.** AI was subject to critiques and financial setbacks. AI researchers had failed to appreciate the difficulty of the problems they faced. Their tremendous optimism had raised expectations impossibly high, and when the promised results failed to materialize, funding for AI disappeared



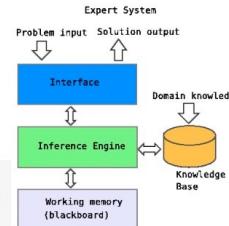
1987-1993

**The second AI winter 1987–1993.** The business community's fascination with AI rose and fell in the 80s in the classic pattern of an economic bubble. The collapse was in the perception of AI by government agencies and investors – the field continued to make advances despite the criticism



1956-1974

**The golden years,** There were many successful programs and new directions: Natural language Understanding (first AI program to use a semantic net), Micro-worlds, Neural Networks



1980-1987

**Boom: In the 1980s** a form of AI program called "expert systems" was adopted by corporations around the world and knowledge became the focus of mainstream AI research. In those same years, the Japanese government aggressively funded AI with its fifth generation computer project.



1993-2001

It began to be used successfully throughout the technology industry. Milestones and Moore's Law: On 11 May 1997, Deep Blue became the first computer chess-playing system to beat a reigning world chess champion, Garry Kasparov. Intelligent agents, Algorithms originally developed by AI researchers began to appear as parts of larger systems. AI had solved a lot of very difficult problems and their solutions proved to be useful throughout the technology industry, such as data mining, industrial robotics, logistics, speech recognition, banking software, medical diagnosis and Google's search engine



# History of AI



1952

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Oliver Selfridge, Nathaniel Rochester, Marvin Minsky, John McCarthy



Ray Solomonoff, Peter Milner (?), Claude Shannon

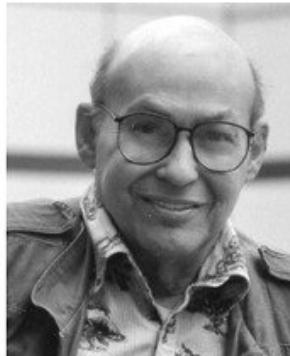


# History of AI

## 1956 Dartmouth Conference: The Founding Fathers of AI



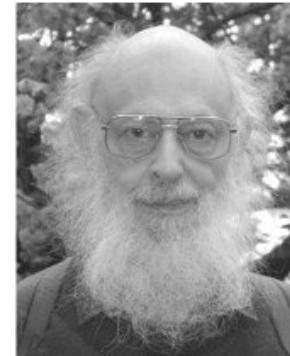
**John MacCarthy**



**Marvin Minsky**



**Claude Shannon**



**Ray Solomonoff**



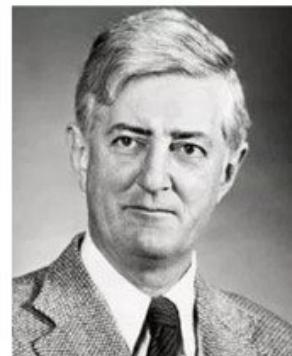
**Alan Newell**



**Herbert Simon**



**Arthur Samuel**



**Oliver Selfridge**



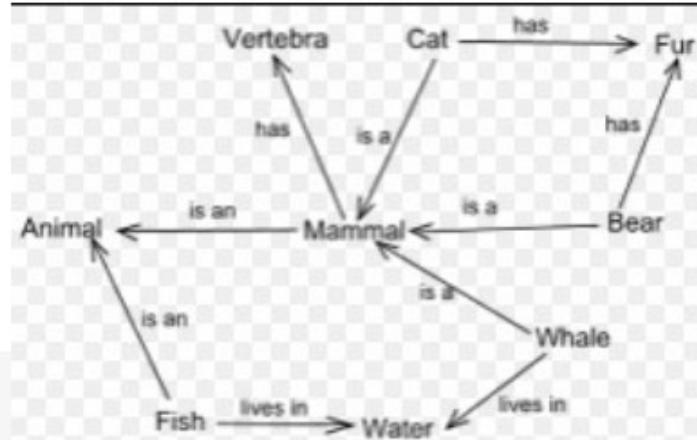
**Nathaniel Rochester**



**Trenchard More**



# History of AI



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# History of AI



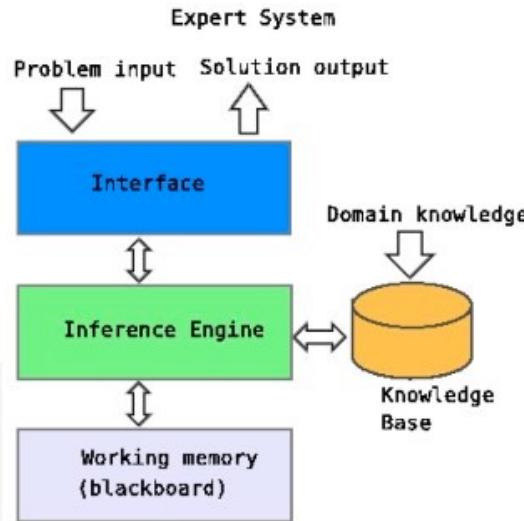
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# History of AI



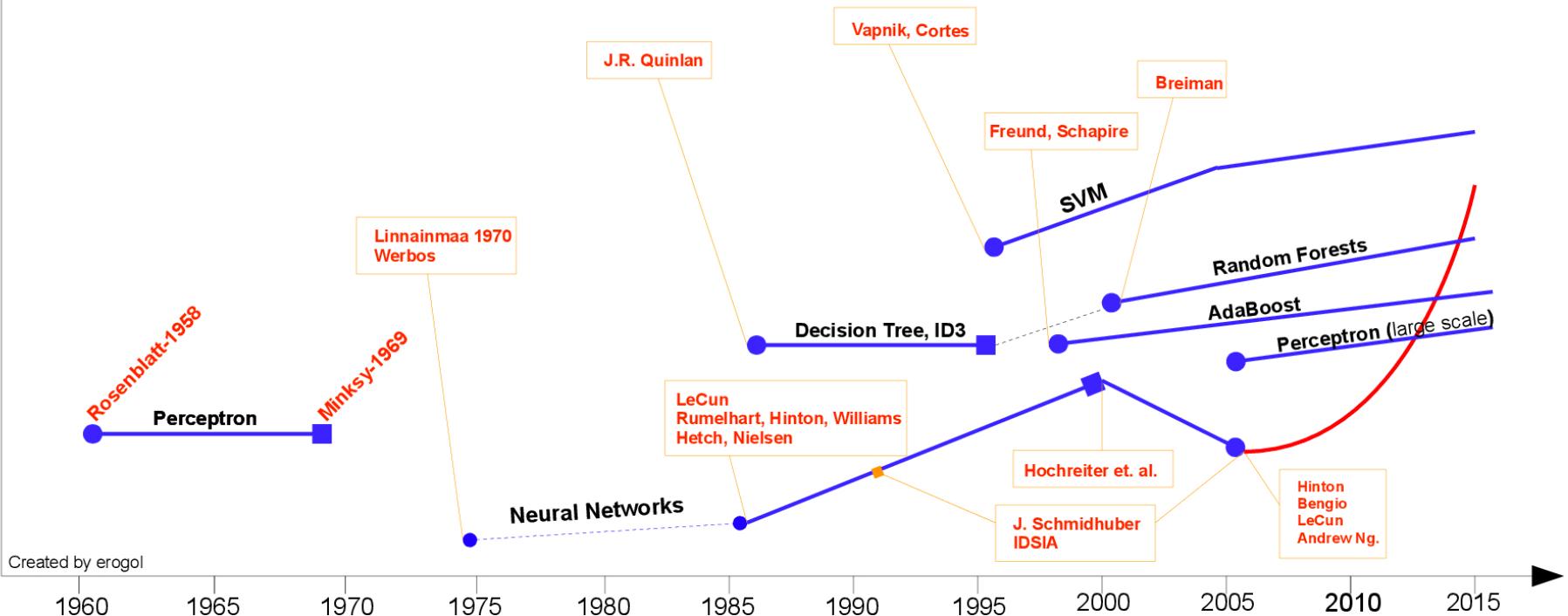
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# History of machine learning

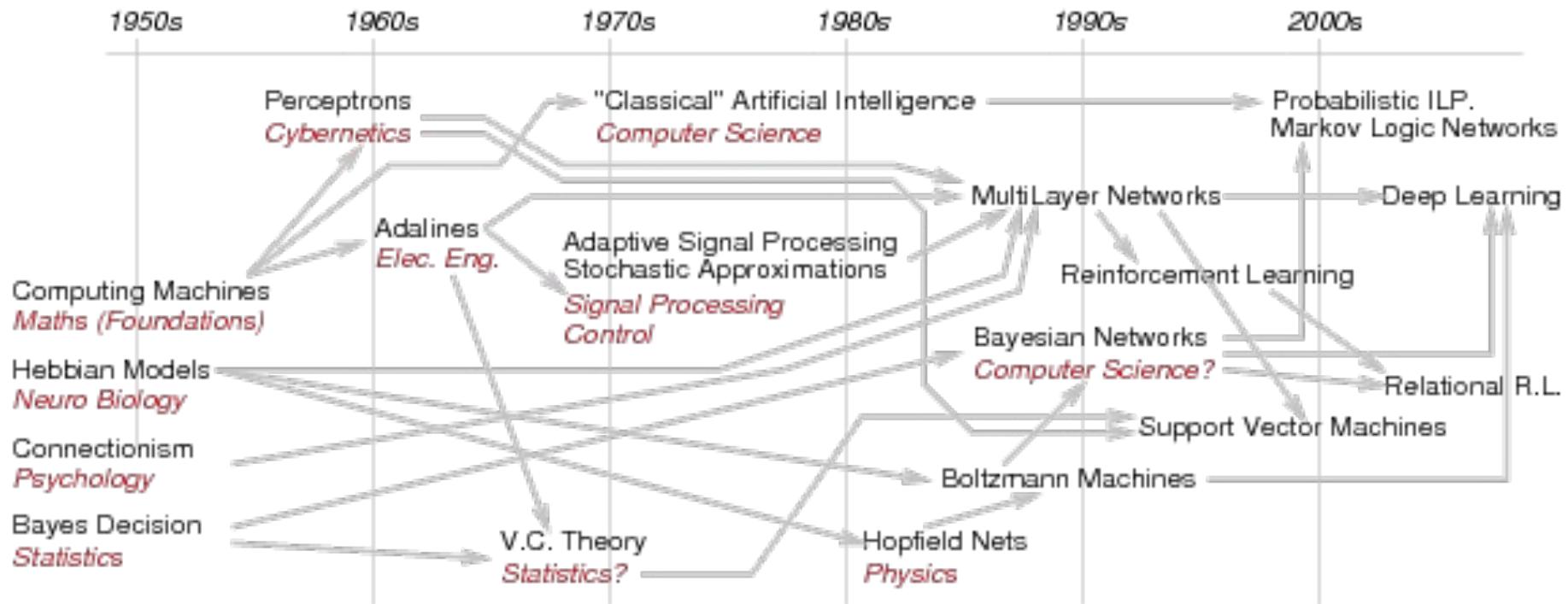
Subjective Popularity



Created by erogol

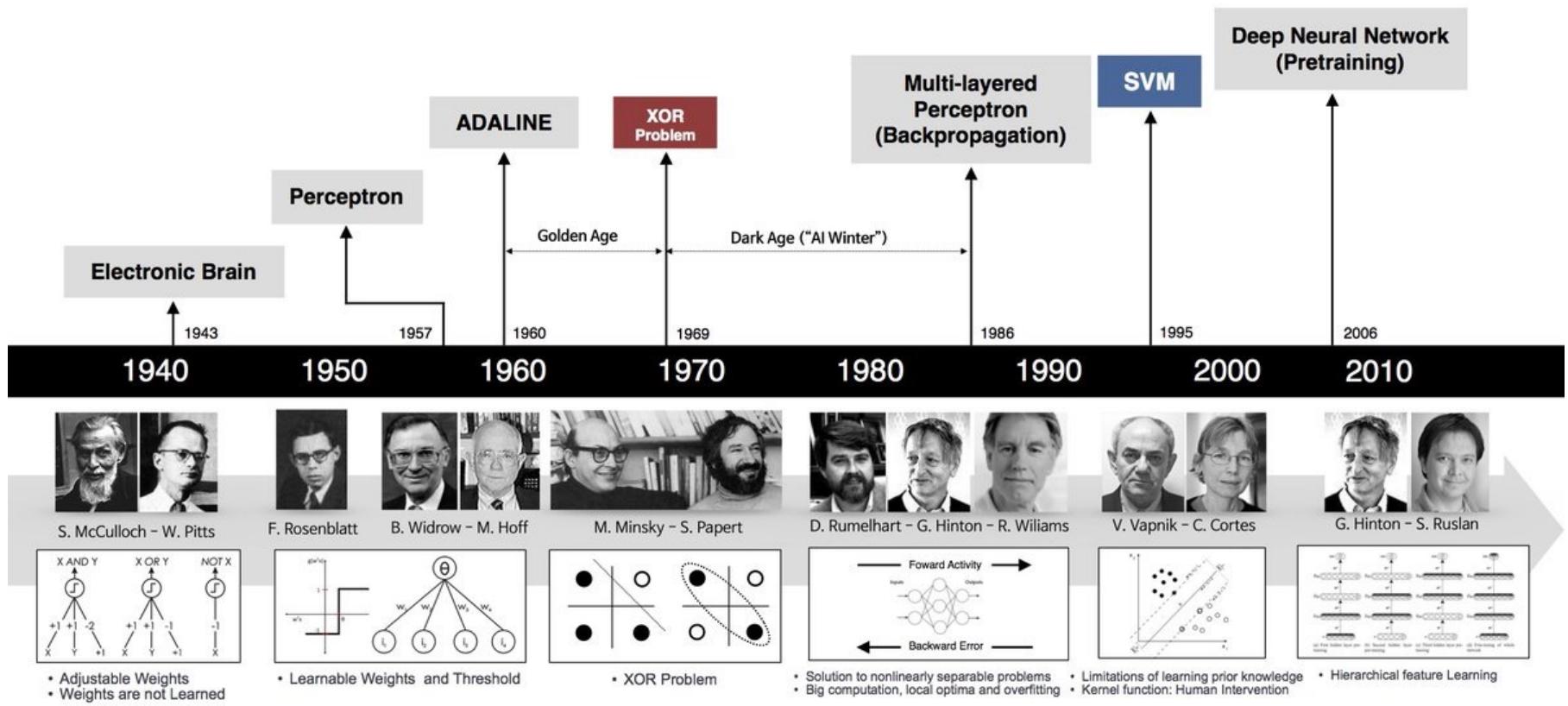


# History of machine learning



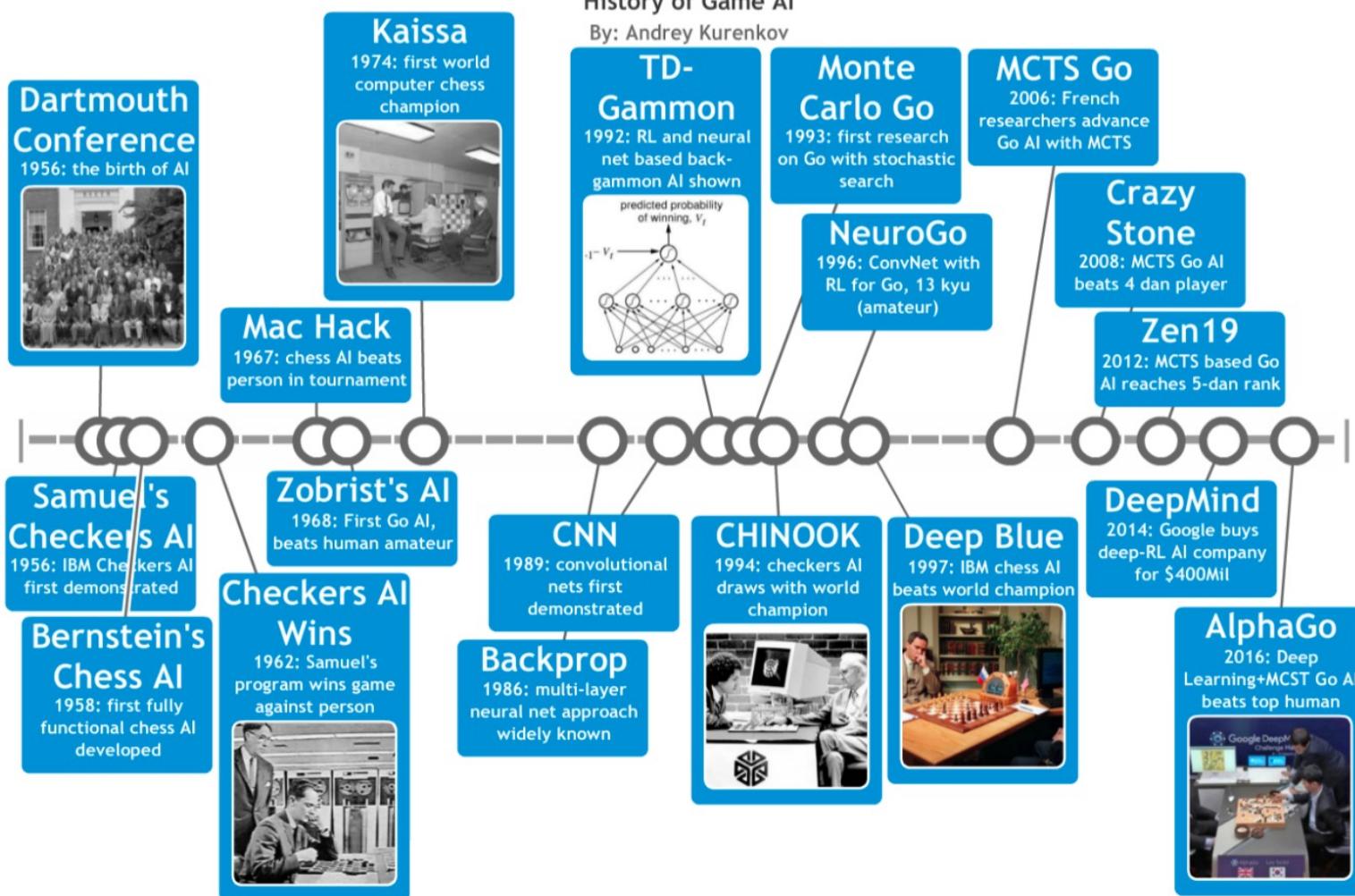


# History of deep learning





# History of Game AI





## ARTICLE

doi:10.1038/nature16961

# Mastering the game of Go with deep neural networks and tree search

David Silver<sup>1\*</sup>, Aja Huang<sup>1\*</sup>, Chris J. Maddison<sup>1</sup>, Arthur Guez<sup>1</sup>, Laurent Sifre<sup>1</sup>, George van den Driessche<sup>1</sup>, Julian Schrittwieser<sup>1</sup>, Ioannis Antonoglou<sup>1</sup>, Veda Panneershelvam<sup>1</sup>, Marc Lanctot<sup>1</sup>, Sander Dieleman<sup>1</sup>, Dominik Grewe<sup>1</sup>, John Nham<sup>2</sup>, Nal Kalchbrenner<sup>1</sup>, Ilya Sutskever<sup>2</sup>, Timothy Lillicrap<sup>1</sup>, Madeleine Leach<sup>1</sup>, Koray Kavukcuoglu<sup>1</sup>, Thore Graepel<sup>1</sup> & Demis Hassabis<sup>1</sup>

The game of Go has long been viewed as the most challenging of classic games for artificial intelligence owing to its enormous search space and the difficulty of evaluating board positions and moves. Here we introduce a new approach to computer Go that uses ‘value networks’ to evaluate board positions and ‘policy networks’ to select moves. These deep neural networks are trained by a novel combination of supervised learning from human expert games, and reinforcement learning from games of self-play. Without any lookahead search, the neural networks play Go at the level of state-of-the-art Monte Carlo tree search programs that simulate thousands of random games of self-play. We also introduce a new search algorithm that combines Monte Carlo simulation with value and policy networks. Using this search algorithm, our program AlphaGo achieved a 99.8% winning rate against other Go programs, and defeated the human European Go champion by 5 games to 0. This is the first time that a computer program has defeated a human professional player in the full-sized game of Go, a feat previously thought to be at least a decade away.

Jan. 2016

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# AlphaGo, Master, AlphaGo Zero, AlphaZero



Mar. 2016



May 2017

<https://d1c50x50snmhul.cloudfront.net/wp-content/uploads/2017/01/04171004/gettyimages-515358458.jpg>  
[https://cdn-images-1.medium.com/max/2000/1\\*do6bDqxzHog67luH77-pAA.jpeg](https://cdn-images-1.medium.com/max/2000/1*do6bDqxzHog67luH77-pAA.jpeg)

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# DeepMind plays StarCraft II



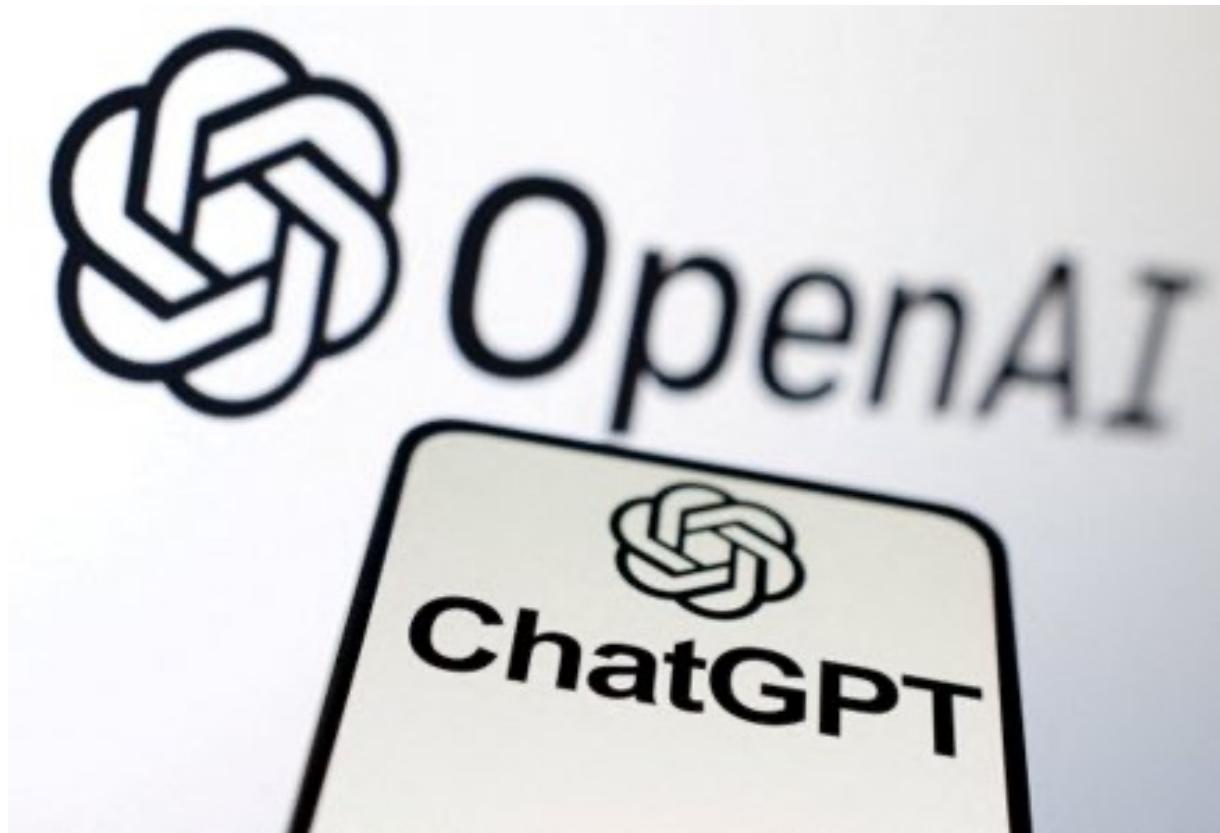
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<http://team-dignitas.net/uploads/tinymce/images/scout.jpg>

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# ChatGPT

Nov./Dec. 2022





# Applications of machine/deep learning



# Handwriting detection





# Fingerprint detection



[http://biometrics.mainguet.org/types/fingerprint/algo/whorl\\_loop\\_arche.jpg](http://biometrics.mainguet.org/types/fingerprint/algo/whorl_loop_arche.jpg)  
<http://biometrics.mainguet.org/types/fingerprint/algo/minutiae.jpg>



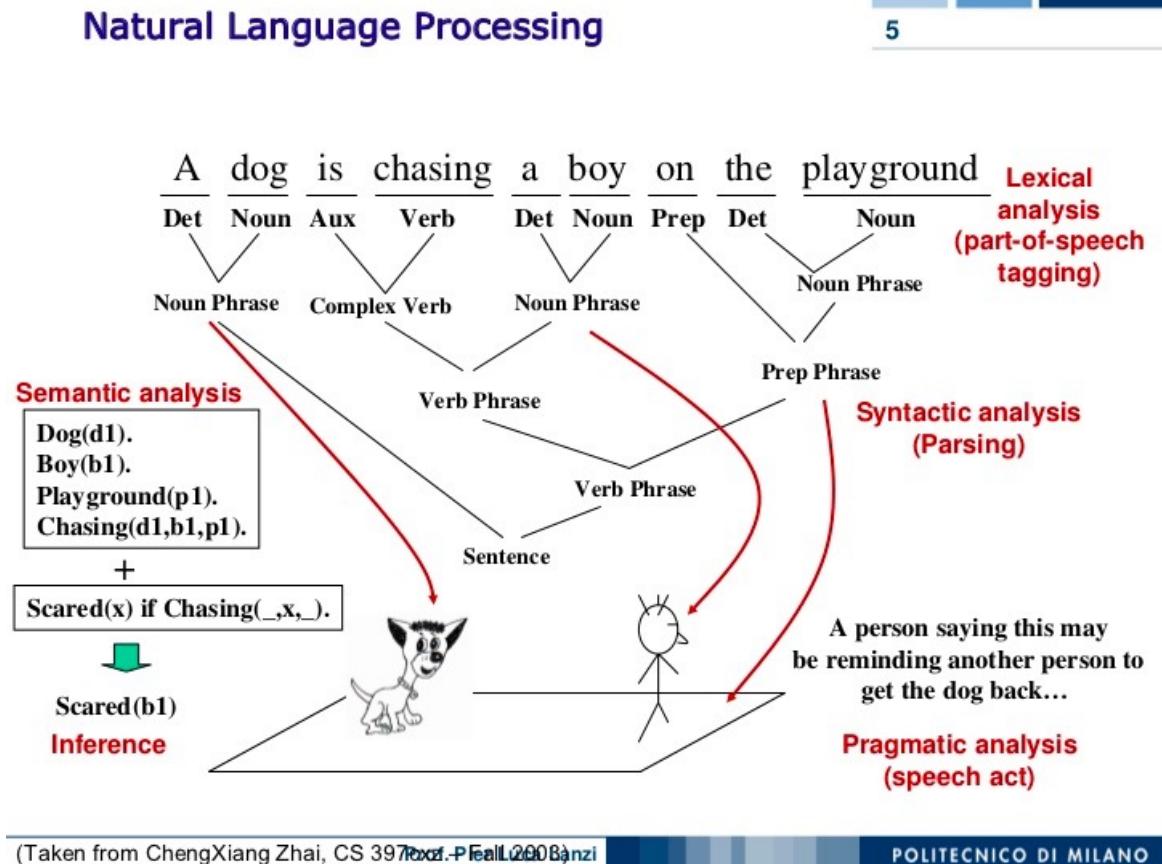
# Spam email filter





# Natural language processing (NLP)

- Text understanding





# Natural language processing (NLP)

- **Translation: Which is by Hemingway? (Which is by Google Translate?)**

Kilimanjaro is a snow-covered mountain 19,710 feet high, and is said to be the highest mountain in Africa. Its western summit is called the Masai “Ngaje Ngai,” the House of God. Close to the western summit there is the dried and frozen carcass of a leopard. No one has explained what the leopard was seeking at that altitude.

Kilimanjaro is a mountain of 19,710 feet covered with snow and is said to be the highest mountain in Africa. The summit of the west is called “Ngaje Ngai” in Masai, the house of God. Near the top of the west there is a dry and frozen dead body of leopard. No one has ever explained what leopard wanted at that altitude.

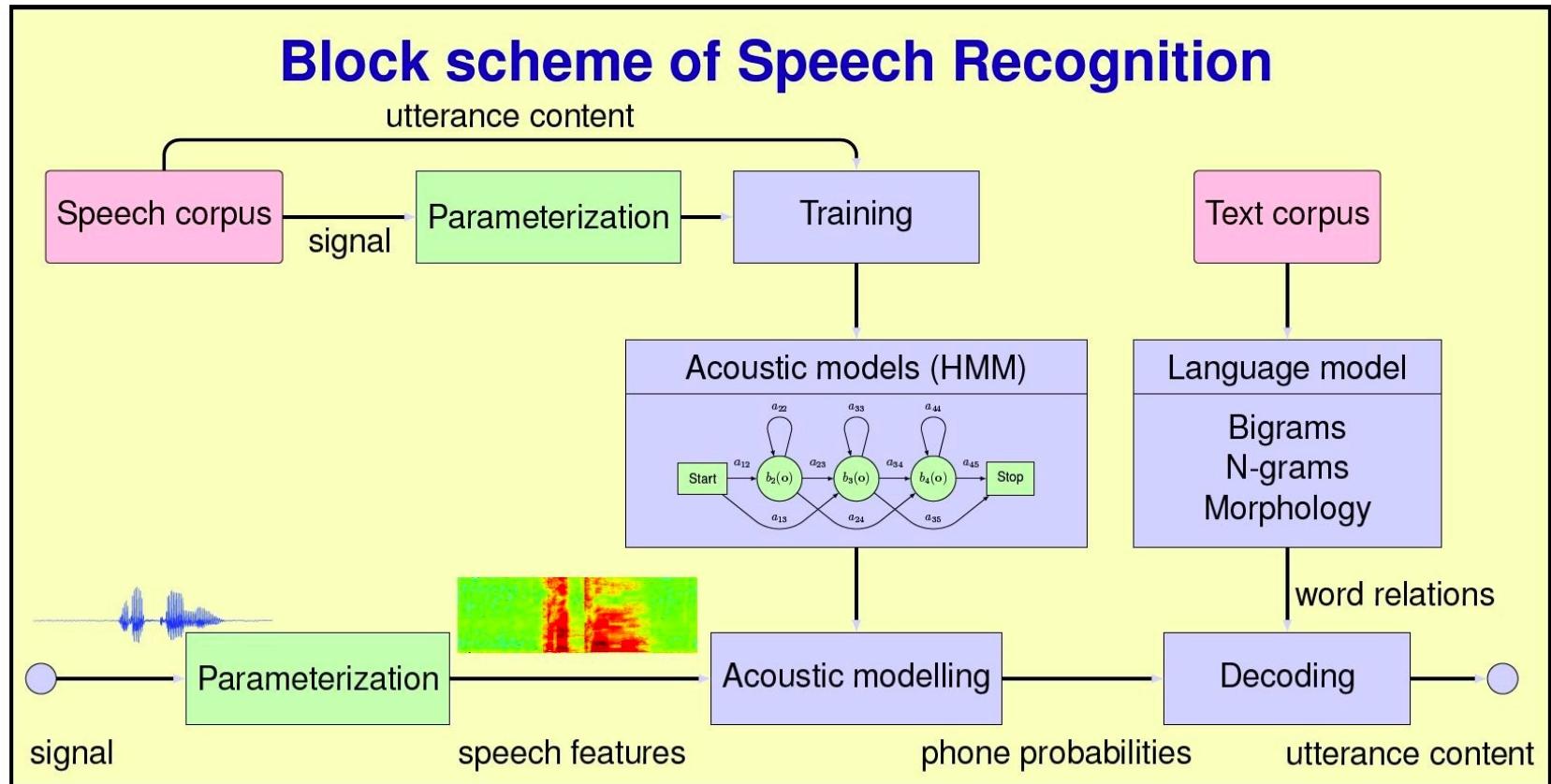


# Speech recognition





# Speech recognition





# Music genre classification





# Music genre classification

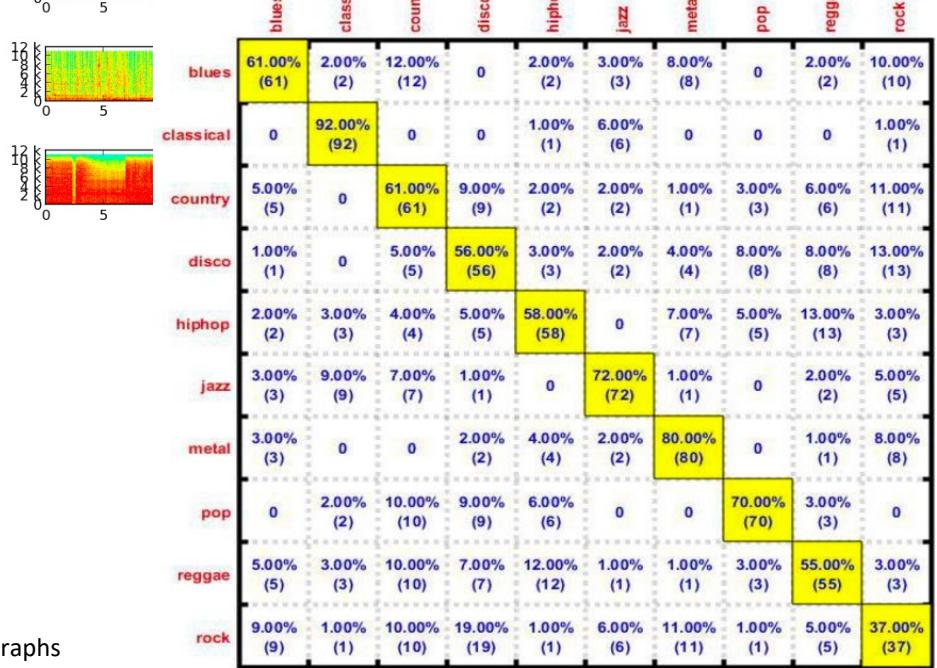
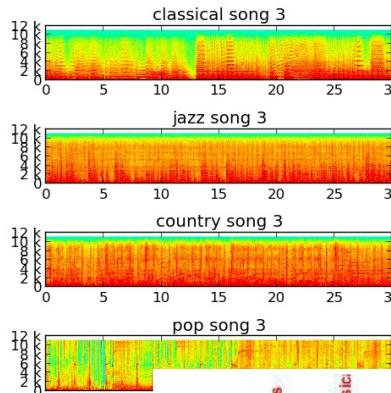
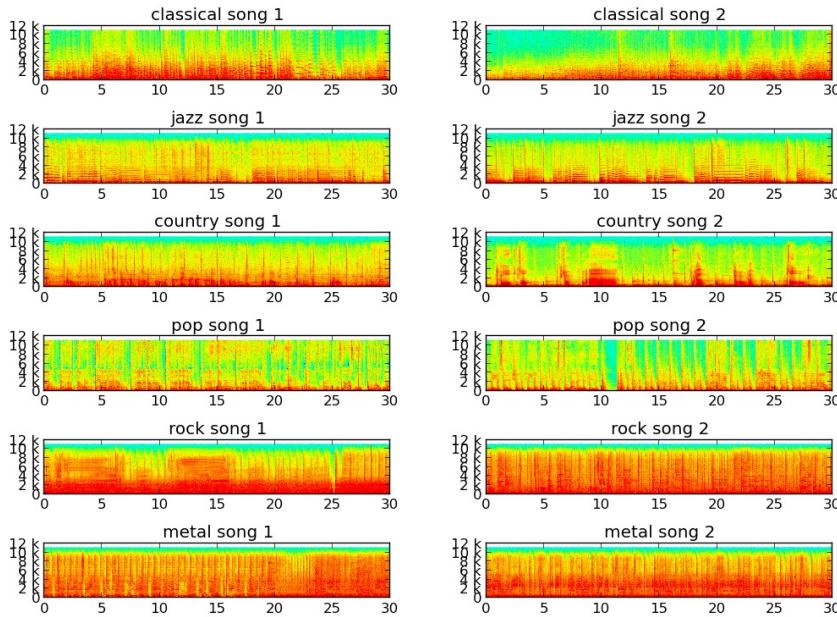


Fig. 7. SVM with reduced dimensions.

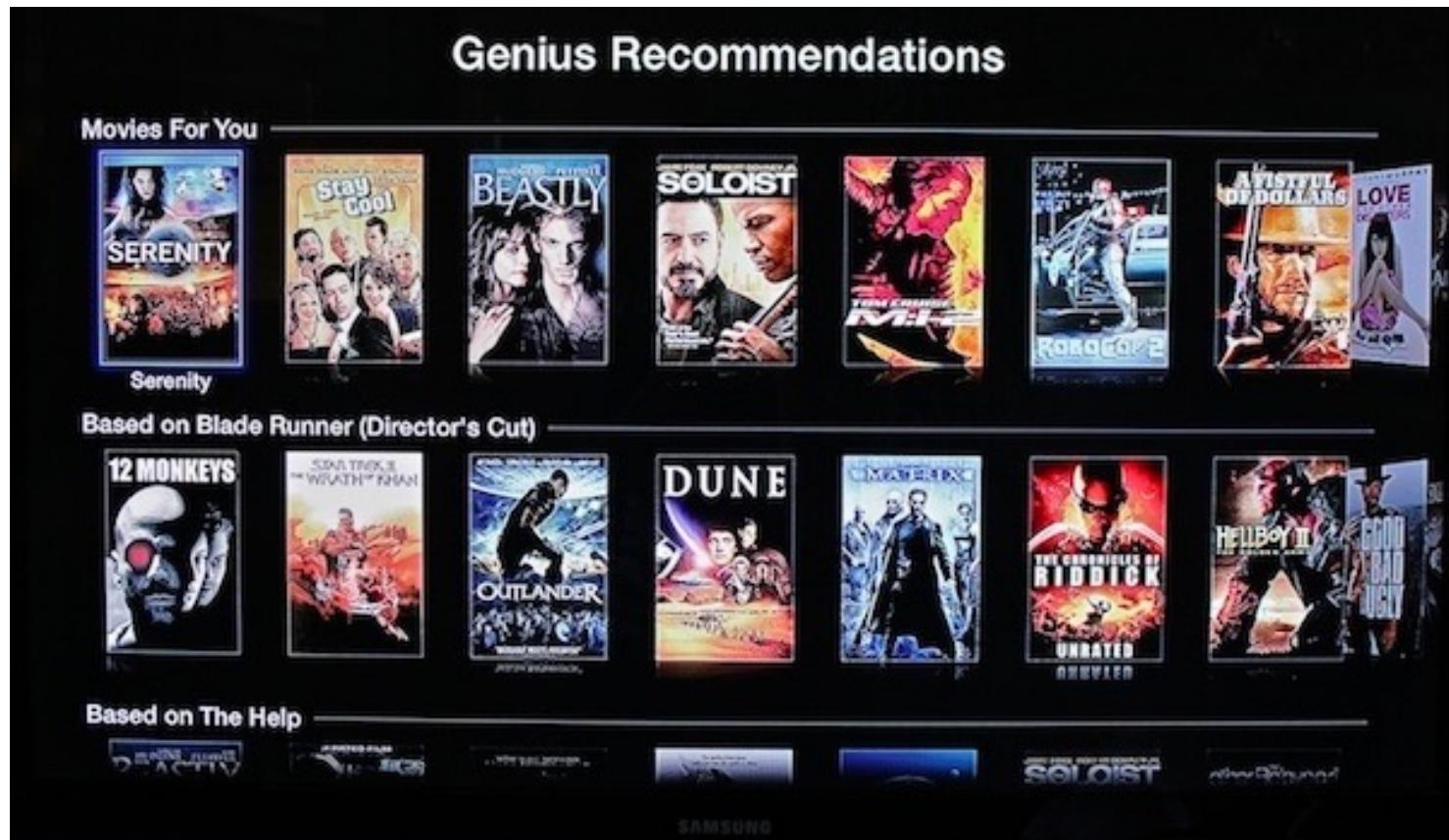
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<https://ai2-s2-public.s3.amazonaws.com/figures/2017-08-08/e272ce9dd8c7adec73817135d053f5819d968082/6-Figure7-1.png>



# Recommendation system

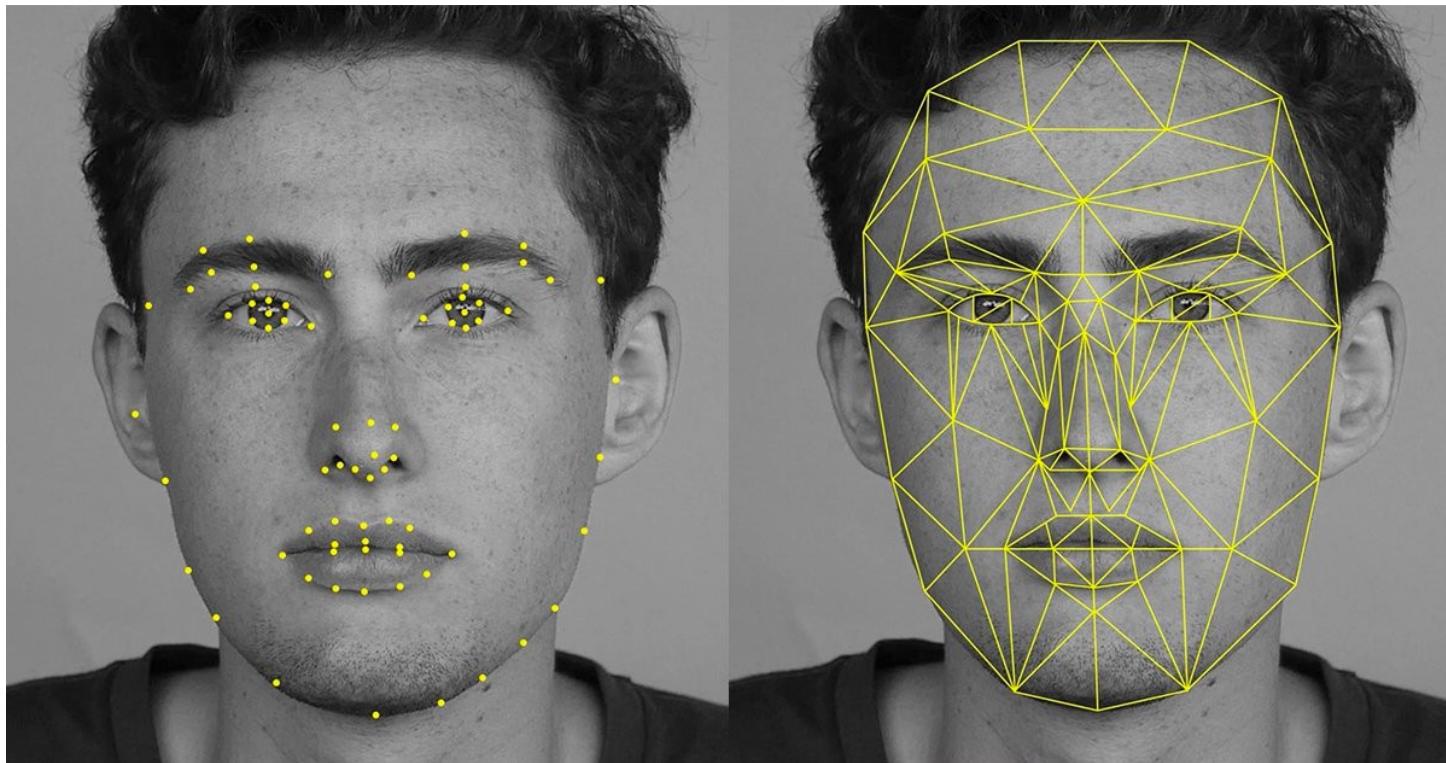
- Music/movie/video/shopping recommendation



[https://o.aolcdn.com/images/dims?quality=100&image\\_uri=http%3A%2F%2Fwww.blogcdn.com%2Fwww.engadget.com%2Fmedia%2F2012%2F02%2Fappletv2.020312.jpg&client=cbc79c14efcebee57402&signature=8eeeeec4130169746e4a35a1cf0793fce75f196f](https://o.aolcdn.com/images/dims?quality=100&image_uri=http%3A%2F%2Fwww.blogcdn.com%2Fwww.engadget.com%2Fmedia%2F2012%2F02%2Fappletv2.020312.jpg&client=cbc79c14efcebee57402&signature=8eeeeec4130169746e4a35a1cf0793fce75f196f)



# Face recognition





# Emotion detection





# Object recognition

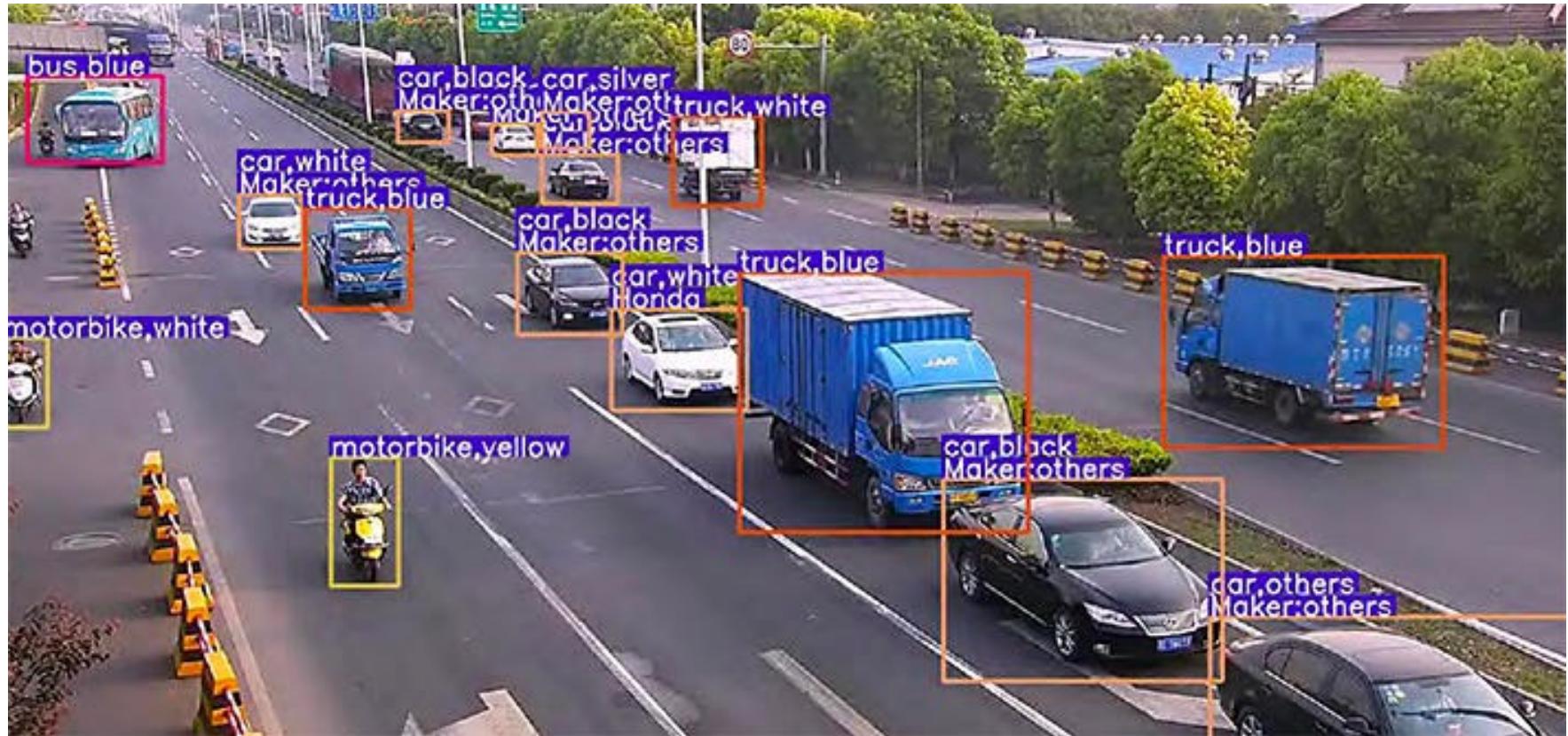


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# Surveillance camera





# Surveillance camera



**1. Detection**  
Real-time categorization  
and search of external appearance  
and movement features

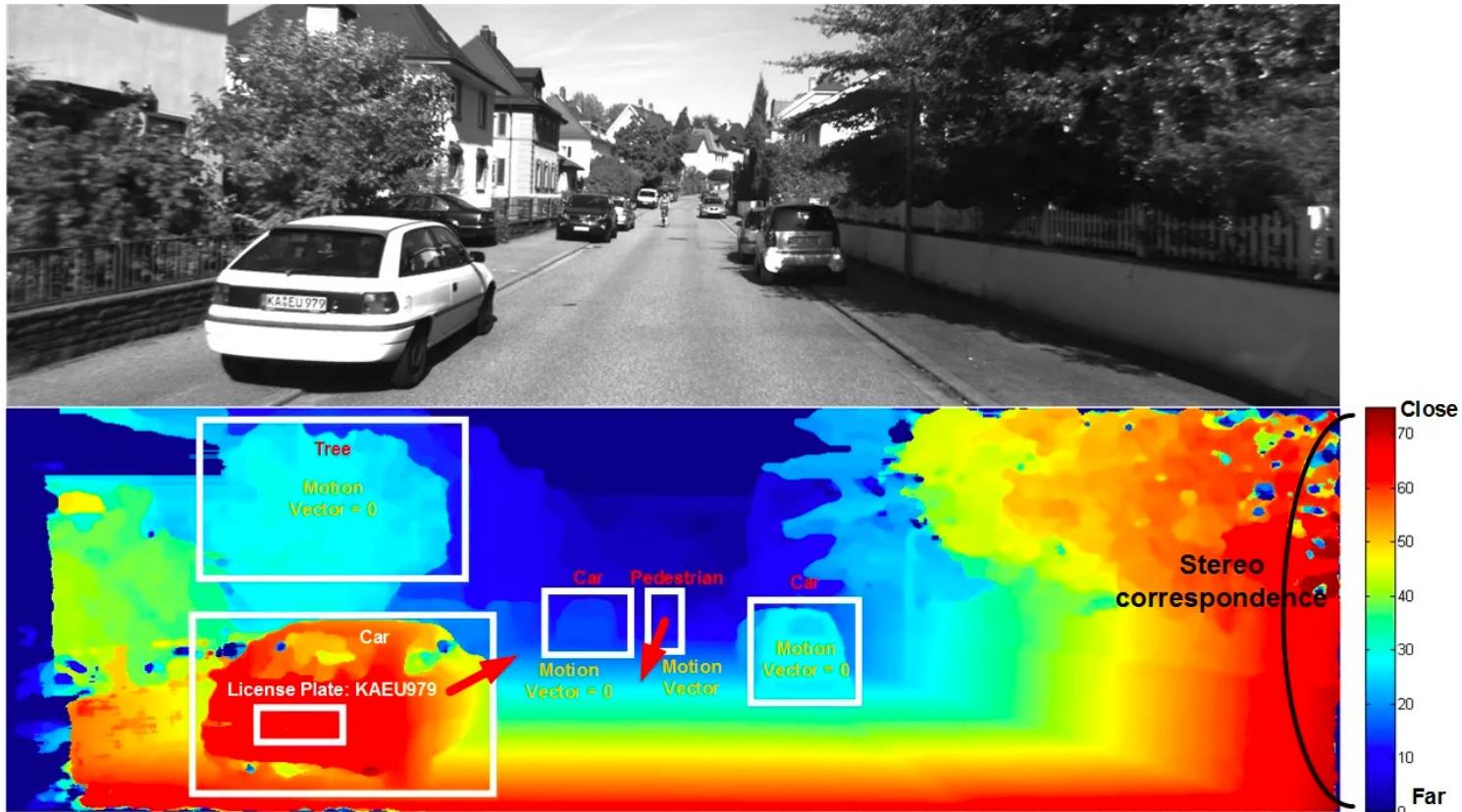


**2. Tracking**  
Analysis of the entire body image,  
and extract images of the same  
person



# Self-driving cars

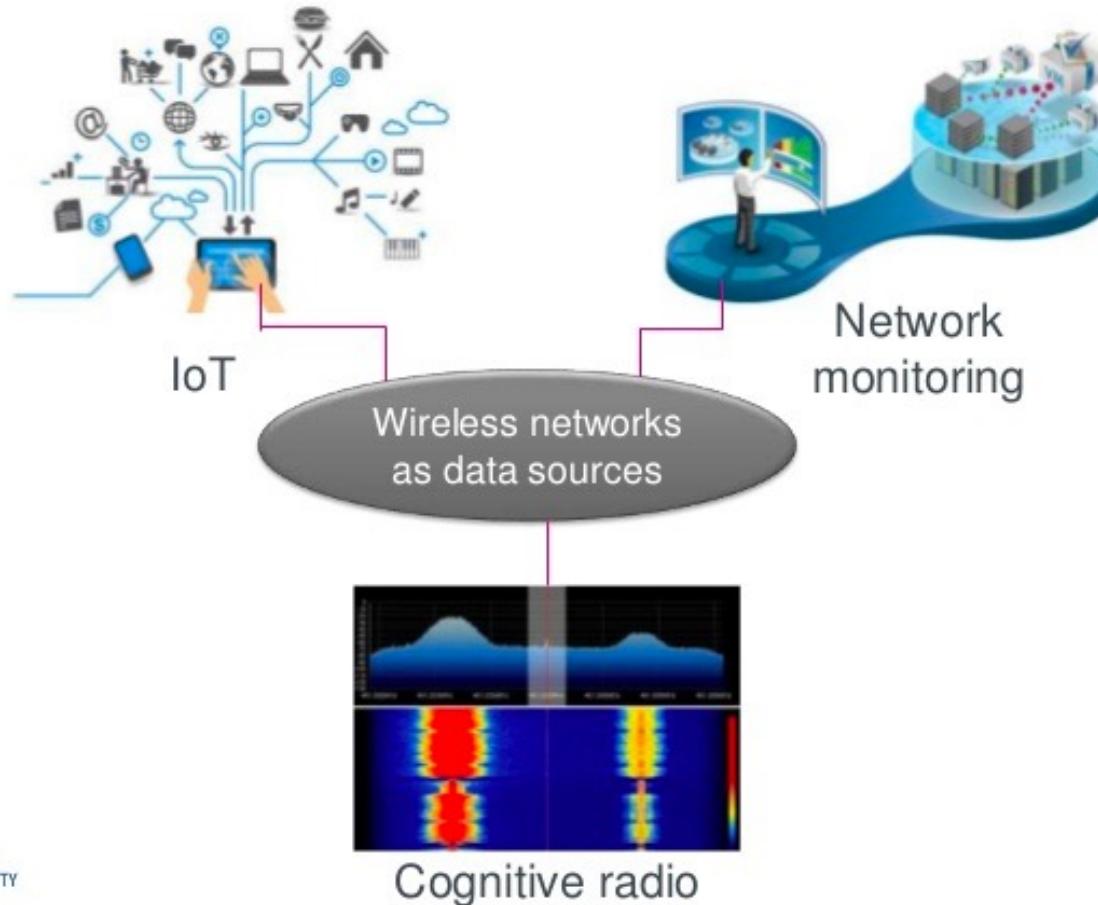
- Road detection, pedestrian detection





# Wireless communications/network

What kind of data are generating wireless networks?



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# Fintech

- Precision marketing



## Understanding your Shopper's Purchase Graph & Cycles



ARF AUDIENCE 2015  
MEASUREMENT

@The\_ARF #ARFAM2015

<https://image.slidesharecdn.com/084b8551-2a96-46de-bdd2-251183d1cd72-150624164355-lva1-app6892/95/precisionmarketingplaybook-8-638.jpg?cb=1435164448>

<http://slideplayer.com/6915664/23/images/2/PRECISION+MARKETING+MEETS+BRAND+ADVERTISING.jpg>

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- Automatic trading

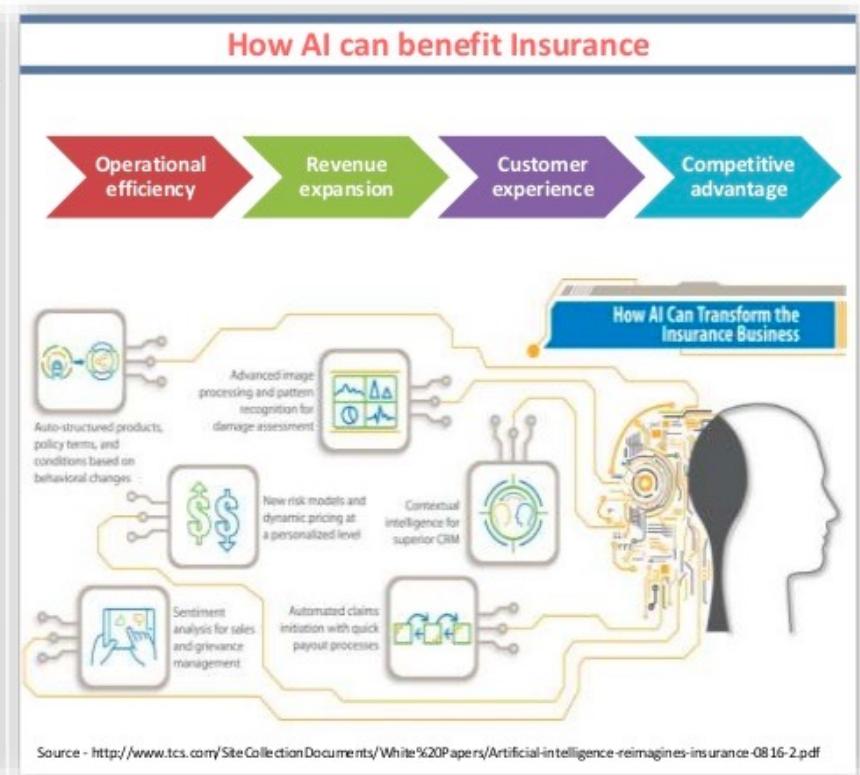




# Fintech



## Disrupting (& Improving) Insurance



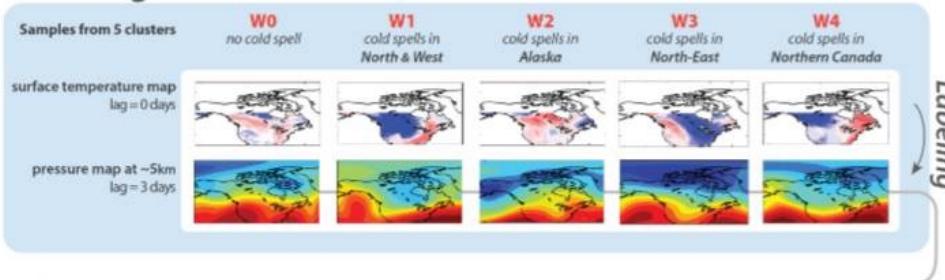
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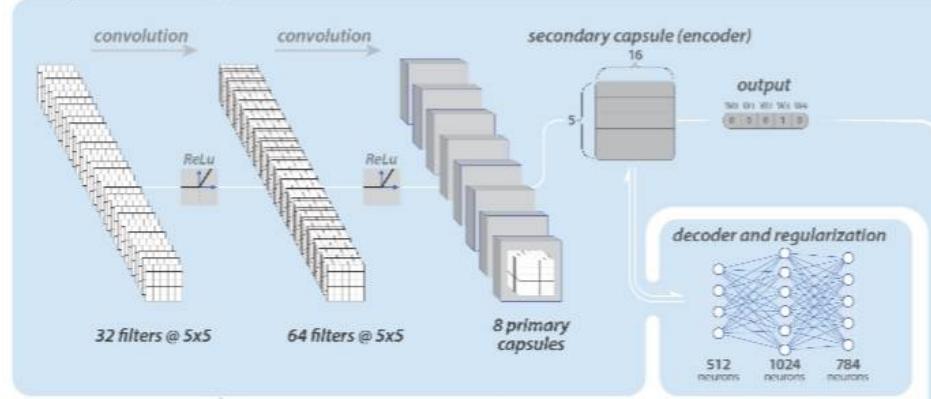
# Earth science

- Weather prediction

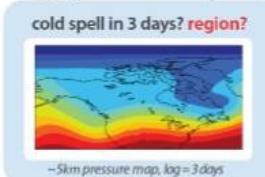
## Training



## CapsNet



## Test

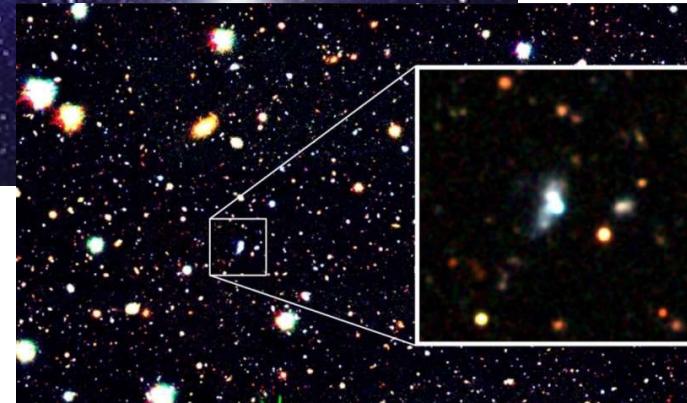


## Prediction result





# Astronomy



<https://www.illinoistimes.com/springfield/astronomy/Content?oid=11493849>

<https://phys.org/news/2020-08-machine-early-galaxy.html>



# Solving math problems

AlphaProof

AlphaGeometry 2



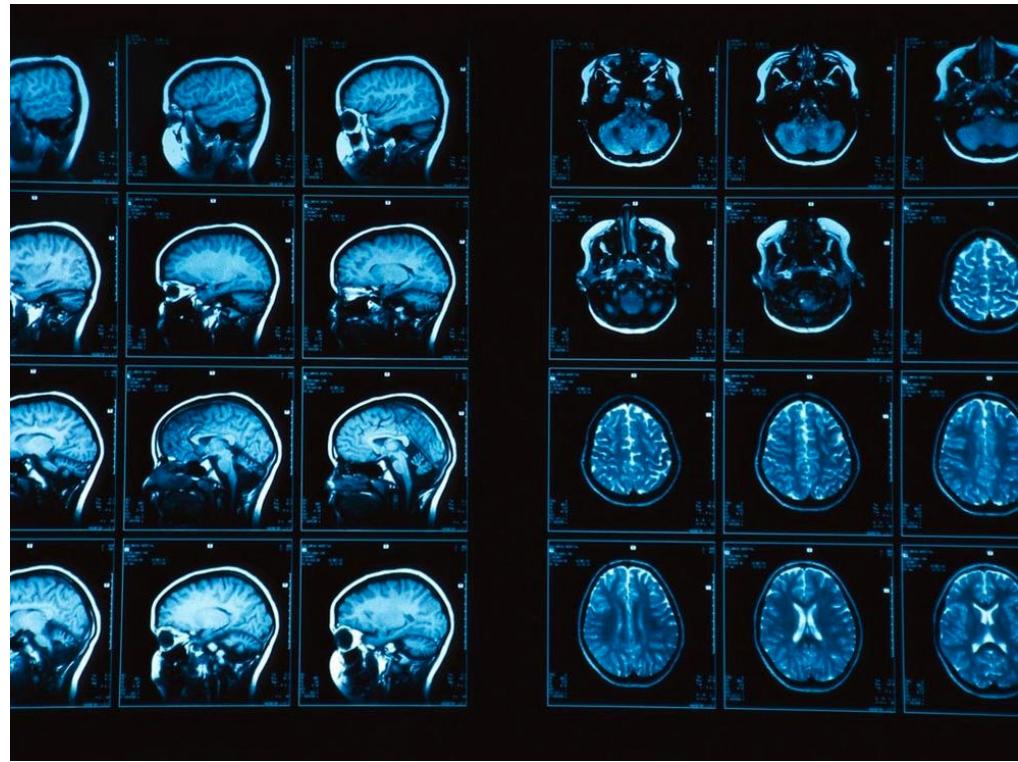
<https://deepmind.google/discover/blog/alphageometry-an-olympiad-level-ai-system-for-geometry/>

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# Medical imaging

- MRI



- Precision medicine

[http://images.nationalgeographic.com/wpf/media-live/photos/000/008/cache/brain-mri\\_848\\_990x742.jpg](http://images.nationalgeographic.com/wpf/media-live/photos/000/008/cache/brain-mri_848_990x742.jpg)

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# Art creation

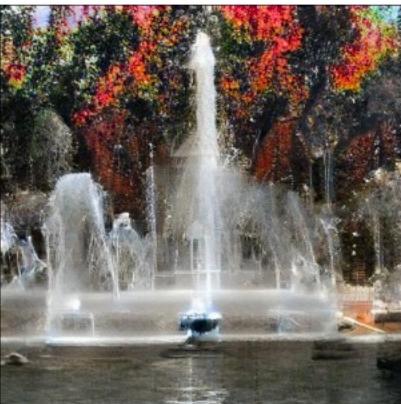


Yating  
(雅婷)

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# Image/video generation





# Image/video generation

## Deepfake

<https://www.abc.net.au/news/2018-09-27/fake-news-part-one/10308638?nw=0>



# Image/video generation



OpenAI  
SORA

